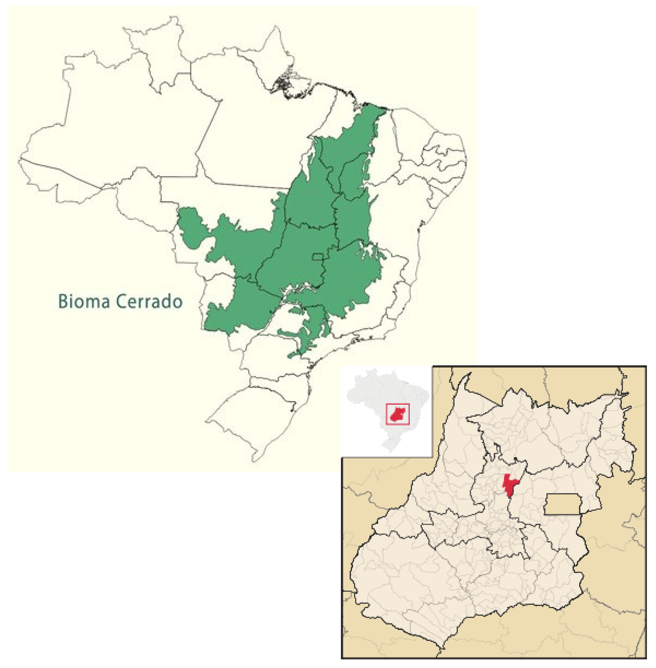

Synergy in Science: Partnering for Solutions

2015 Annual Meeting | Nov. 15-18 | Minneapolis, MN with the Entomological Society of America

ORGANIC SUGARCANE IN BRAZILIAN SAVANNAH: SOIL PHYSICAL PROPERTIES RELATED TO WATER STORAGE AND CARBON

MELLISSA A. SOLER DA SILVA[1*], LURDINEIDE DE A. B. BORGES[2], BEATA E. MADARI[1] AND MARCIA T. M. DE CARVALHO[1]

1) EMBRAPA - National Rice and Beans Research Center of the Brazilian Agricultural Research Corporation (Embrapa Rice and Beans, Project Number 03.14.00.043.00.00 / Scientific Research Foundation of Goias State (FAPEG, Project Number 2012-10267001033), Santo Antônio de Goiás, Goiás, Brazil. Correspondent author: mellissa.soler@embrapa.br

2) Universidade de Brasilia, Brasília - DF, Brazil. CNPQ Felowship.

Introduction

The sugarcane management system in a conventional way affects the soil physical properties, increasing soil density and decreasing soil carbon, porosity, infiltration and hydraulic conductivity compared to the soil under native forest (Silva et al., 2006; Vasconcelos et al., 2014). According to Andrade and Stone (2009), soil quality can be seen under three aspects: physical, chemical and biological, in which physical quality is the most relevant for the assessment of soil degradation level and for the identification of sustainable practices. Investigation about the dynamics of soil organic matter in tropical soils under agriculture can provide valuable information on how soil management can affect C stocks and promote C sequestration (Bayer et al., 2006). The cultivation of organic sugarcane comprises absence of burning, therefore large quantities of biomass is maintained on the soil surface, and that in turn can contribute to increase soil organic matter. The aim of this study was to verify the impact of the adoption of organic agriculture techniques on soil properties related to water and carbon storage in a sugarcane production system of the Brazilian Savannah.

Material and Methods

The study was conducted in a sugarcane production system, located in the municipality of Goianésia, Goiás State, Central West region of Brazil (15°10'S and 49°15'W and 640 m altitude). The climate is classified as Aw (Kottek et al., 2006), a tropical savannah characterized by very well defined seasons: a dry winter (June to September) and a rainy summer (October to May). Annual average rainfall is about 1,500 mm and the predominant soil type in the region is the clay Oxisol. The sugarcane production system was established in an area that used to be explored as low input grazing for more than 20 years. The treatments consisted of four areas of 1 ha each, under a sugarcane production system, differing only in the type of management and duration of adoption of organic techniques (Table 1). The experimental design was completely randomized, with five replications and four treatments. Assessment of soil properties was done from December 2010 to January 2011. Modelling and testing the shape parameters of the soil water retention curves was done according to the method proposed by Carvalho et al. (2014), considering potential correlation among measurements taken within the same soil core sample. For other soil variables, the Scott-Knott means test ($p < 0.05$) was applied for comparison of the treatment reference (Org0) with organic farming treatments. The R software was used for modelling data (Team, 2013).

Table 1. Main operations carried out during sugarcane cultivation

Treatments	Description	Soil texture at 0-20 cm depth (g kg^{-1})		
		Clay	Silt	Sand
Org0	Treatment reference. Area cultivated under conventional farming without burning since 2001. The sugarcane was planted in 15/April/2008 and a second harvest was realized in 2010.	451	168	381
Org2	Area cultivated under organic farming for two years, since 2006. The sugarcane was planted in 05/15/2006 and a third harvest was realized in 04/August/2010.	538	205	257
Org10	Area cultivated under organic farming for ten years, since October 2000. The sugarcane was planted in 1998. In 2003 and 2009, was carried out sugarcane renovation, ie, plowing followed by harrowing and new sugarcane cultivation with liming (1.5 t ha^{-1}) and natural phosphate (1 t ha^{-1}), after *Crotalaria* sp. cultivation and incorporation. Sugarcane filter waste was applied in the sowing lines. The first harvest after last renovation was realized in 10/July/2010.	505	198	297
Org10SR	Area cultivated under organic farming for ten years, without renovation, since March 2000. The last renovation occurred in 15/April/1998. Every year a harvest was realized and a twelfth harvest was realized in 12/July/2010.	522	238	240

Results

Table 2. Total soil carbon (TC) in 0-10, 20-30 and 40-50 cm depth of a clay Oxisol under a sugarcane production system with varying management: conventional farming (Org0), organic farming for 2 years (Org2), and organic farming for 10 years with (Org10) and without renovation (Org10SR).

Treatment	Total Carbon (%)*		
	0 – 10 cm	20 – 30 cm	40 – 50 cm
Org0	1.240 c	0.878 c	0.746 c
Org2	1.586 c	1.218 b	0.920 b
Org10	2.538 a	1.466 a	1.138 a
Org10SR	1.943 b	1.233 b	0.912 b

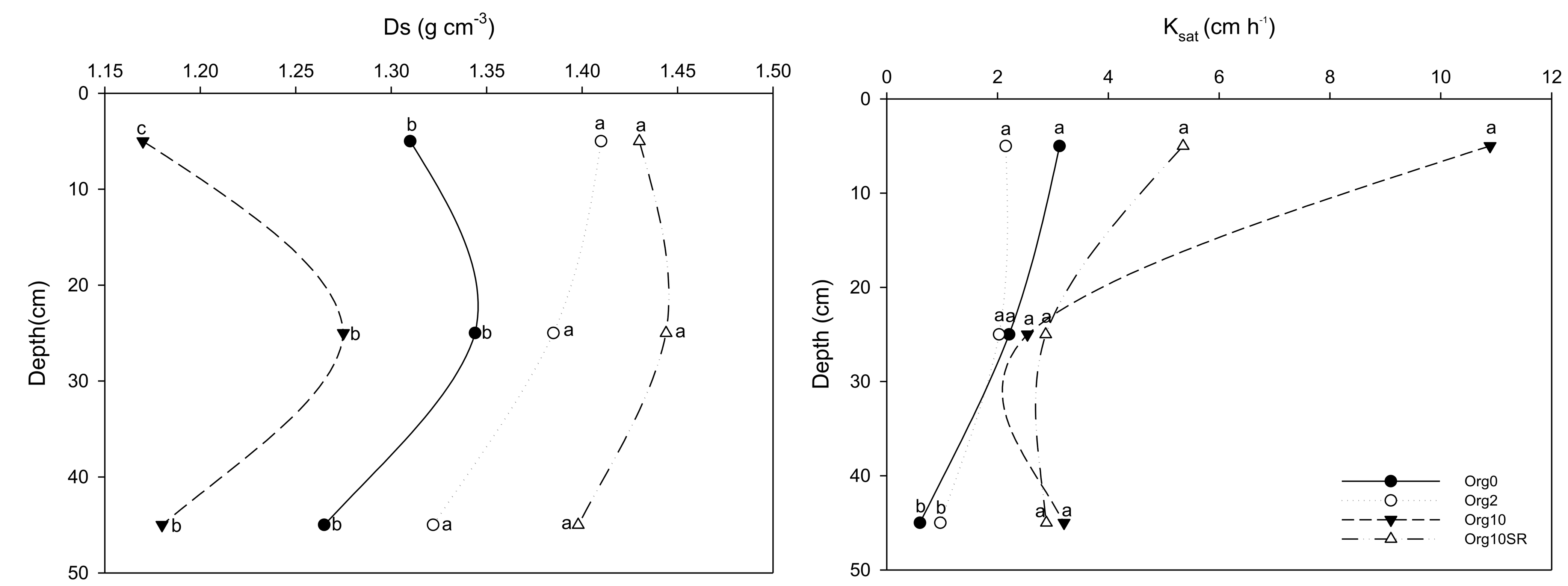

Figure 1. Soil bulk density and Saturated hydraulic conductivity (K_{sat}) in 0-10, 20-30 and 40-50 cm soil depth of a clay Oxisol under a sugarcane production system with varying management: conventional farming (Org0), organic farming for 2 years (Org2) and organic farming for 10 years with renovation (Org10) and without renovation (Org10SR).

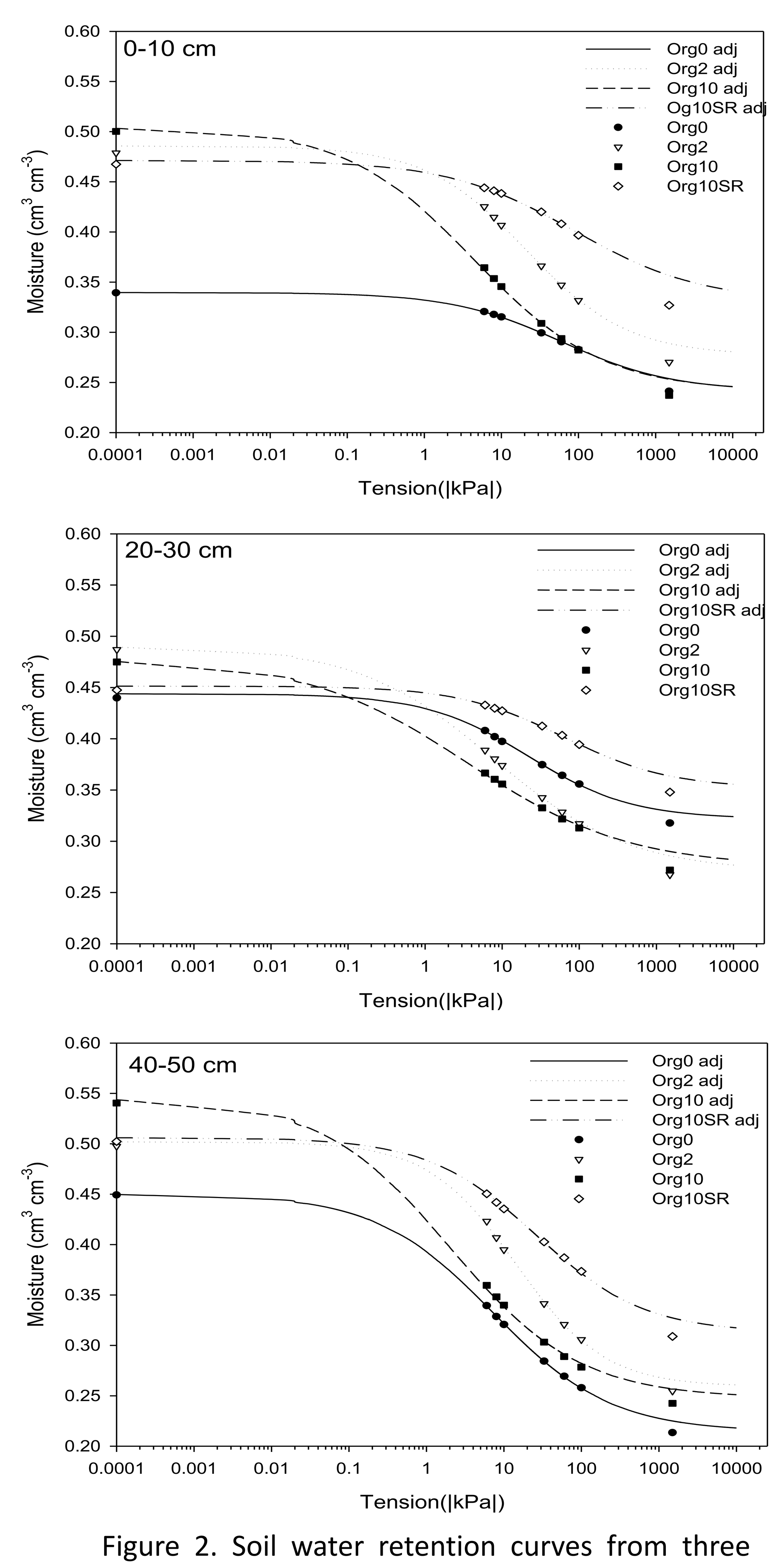

Figure 2. Soil water retention curves from three soil depths (0-10, 20-30 and 40-50 cm) of a clay Oxisol under a sugarcane production system with varying management:

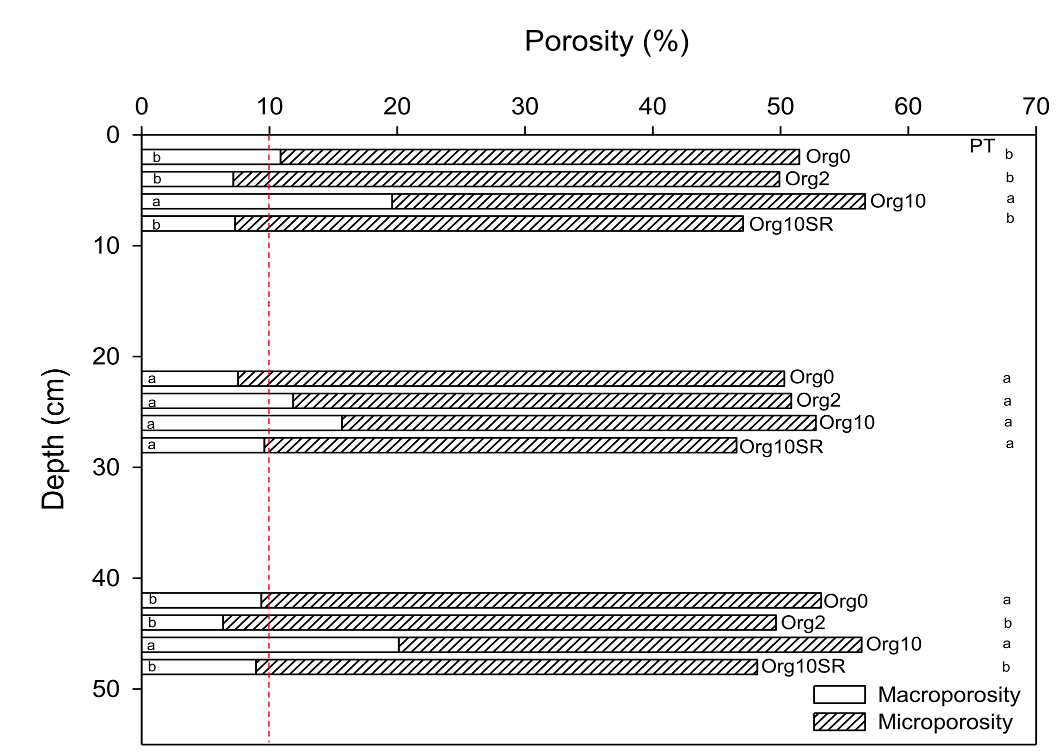

Figure 3. Soil total porosity (macro and micro porosity) in 0-10, 20-30 and 40-50 cm soil depth of a clay Oxisol under a sugarcane production system with varying management: conventional farming (Org0), organic farming for 2 years (Org2) and organic farming for 10 years with renovation (Org10) and without renovation (Org10SR). Means followed by same letters are not statistically different according to the Scott-Knott test ($p < 0.05$). At the bottom of the columns is presented the test for macro porosity and at the top of the columns for total porosity. Micro porosity presented no difference.

Conclusions

Organic sugarcane farming favors improvement of soil water retention capacity, macro porosity, saturated hydraulic conductivity and total C storage. Organic farming allows input of C in soil via biomass increment above and below ground that can enhance formation of macro pores in soil, which in turn are responsible for the movement of water and air in the soil.

FAPEG Fundação de Amparo à Pesquisa do Estado de Goiás

CNPq Conselho Nacional de Desenvolvimento Científico e Tecnológico